Unit 1: Cells, Tissues, Organs, and Systems

Unit 1 - Cells Nelson Science and Technology 8

The Cell Theory

- All living things are composed of cells
- All cells come from pre-existing cells

The cell theory has helped scientists to understand the workings of the human body and the bodies of other living things.

1.2 Microscopes

Blackline Master 1.2.1 The Parts of a Compound Microscope

Blackline Master 1.2.2 Diagram for labelling: Microscope

Blackline Master 1.2.3 Careful Use of a Microscope

Review the magnification of each lens and the ocular lens (where 40X, 100X, and 400X come from)

1.3 Plant and Animal Cells

Unicellular vs. Multicellular Living Things

1. Unicellular:

- Composed of only one cell
- Bacteria, protists, and some fungi

2. Multicellular:

- Composed of many specialized cells
- Plants, animals, some fungi

Animal Cell Structures and Plant Cell Structures

Blackline Master 1.3.1 Diagram for labelling: Parts of Plant and Animal Cells

Follow diagrams on page 12 and 13

Parts of the Animal Cell: (divided by the role they play in the cell)

A- Control:

- Nucleus: controls the activities of the cell (control centre: brain).
- Chromosomes: inside the nucleus, they contain the "genetic material" of the cell, strands of DNA (construction plan, blueprint).

B- Materials:

- Cell Membrane: controls materials (nutrients and waste) in and out of the cell (door, gate-keeper).
- Cytoplasm: watery fluid, allows materials to be transported in the cell, stores materials.

C- Materials storage:

- Vacuole: filled with fluid, stores water and nutrients such as sugar and minerals.

D- Structures that help cells move

- Flagellum: "tail" that allows cells to move; found on some cells. Means "little whip". Example: slime mould called "myxomycetes", a yellow,

orange and red mould found on decaying wood, leaves and organic matter.

- Cilia: "tiny hairs" that allow cells to move; found on some cells. Means "eyelash". Example: paramecium

Parts of the Plant Cell: (divided by the role they play in the cell)

They have the same structures as the animal cell and other structures not found in animal cells. The cell membrane is hard to see in plant cells. They are more "rectangular" than animal cells.

C- Materials storage:

- Vacuole: filled with fluid, takes up a larger part of the cytoplasm of a plant cell; stores water and nutrients.

E- Protection:

- Cell wall: protects and supports the plant cell. It is rigid and controls gases, water and some minerals leaving and entering the cell through small pores.

F- Food production

- Chloroplasts: contain chlorophyll (green); they allow plants to make their own food using light from the sun (photosynthesis). They are not present in animal cells.

1.6 Parts of a Cell Seen with an Electron Microscope

The cytoplasm, the working area of every cell, contains special structures called **organelles**. These organelles described below are found in both plant and animal cells.

A- Energy:

- Mitochondria: provides energy for the cell. Cellular respiration occurs here, mitochondria release energy by combining sugar molecules with oxygen to form carbon dioxide and water.

Cellular respiration allows living things to release energy from food.

$CH_2O + O_2 \rightarrow CO_2 + H_2O$ + energy

B- Protein Manufacturing:

- Ribosomes: protein molecules are manufactured there using information from the nucleus and molecules from the cytoplasm. Proteins are large molecules that are needed for cell growth, for repair and for reproduction.

C- Material Transport:

- Endoplasmic Reticulum: folded membranes that carry materials through the cytoplasm. Sometimes ribosomes are attached to the endoplasmic reticulum and it is then called "rough" endoplasmic reticulum.

D- Protein Storage:

- The Golgi Apparatus: used for protein storage. Also puts proteins into packages called **vesicles**. Vesicles carry the protein molecules to the surface of the cell where they are released to the outside.

E- Recycling:

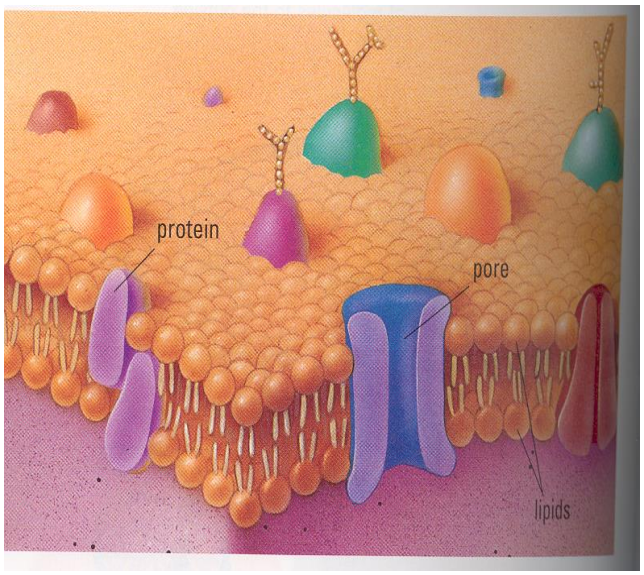
- Lysosomes: contain special proteins that break down large molecules into smaller molecules. The smaller molecules can be reused as building blocks for other large molecules. They also kill and digest invading organisms.

Blackline Master 1.6.1 Diagram for labelling: Parts of Plant and Animal Cells Seen in an Electron Microscope

1.7 Cells in Their Environment

Cell Membranes

- Cells allow some materials to enter or leave depending upon the size of the molecule.
- Called **selectively permeable**
- Permeable means permitting passage and Impermeable means not permitting passage
- See example of cell membrane below:



Diffusion:

Def: movement of molecules from an area of high concentration to an area of low concentration.
Example: A drop of ink is added to a beaker of water

Diffusion and cells

- Movement of molecules through the cell membrane can occur through diffusion.
- A substance that the cell uses up, such as oxygen, will be in low concentration inside the cell. Outside the cell, the concentration of the substance will be higher. The molecules of the substance will diffuse across the cell membrane into the cell. Diffusion will continue until the concentration of the substance is the same inside and outside the cell.

- Waste products, such as CO_2 molecules, tend to become more concentrated inside the cell than outside, so they will diffuse out of the cell.

1.8 Osmosis

Osmosis is a type of **diffusion**

Def**:** The diffusion of **water** through a selectively permeable membrane.

Some facts:

- Water molecules are small and pass through a cell membrane easily.
- Water molecules are constantly passing through the cell membrane both in and out of the cell.
- If an imbalance occurs, more water molecules will move in the direction of the low concentration of water.

Cells in solution of different concentrations

Solute:

Def: a substance that is dissolved in another substance, the solvent. In cells, the salts and sugars are common solutes.

Solvent:

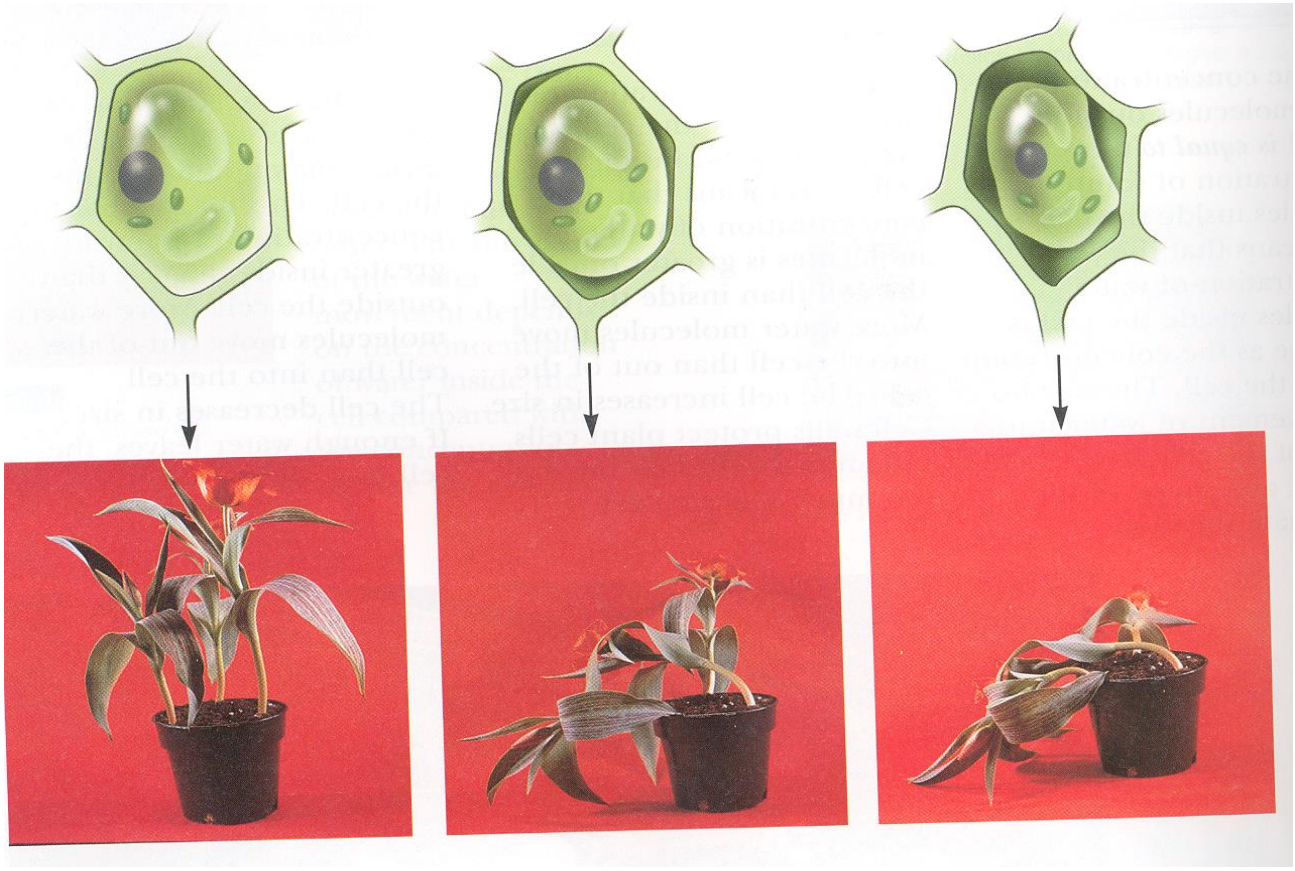
Def: a substance that dissolves another substance, the solute. In cells the solvent is water.

The movement of water into and out of cells is vital to living things and it is driven by imbalances in concentration. Ideally the solute concentration outside the cell should be equal to that inside the cell.

Turgor Pressure:

Def: If the concentration of water outside a plant cell is higher than inside it, water molecules enter the cell by osmosis. The water fills the vacuoles and cytoplasm, causing them to swell up and push against cell wall. This outward pressure is called **turgor pressure**.

Gives the plant or leaf support and structure (gives vegetables "crispness")



1.13 <u>Unicellular Organisms</u>

- Also called microorganisms or microbes since they are only visible under a microscope.
- The single cell is responsible for feeding, digestion, excretion and reproduction.
- Some microorganisms make us sick, but without the others we could not survive.
- The following are examples of unicellular organisms:
    - Bacteria

    - Protists
    - Some Fungi

- Field of study of microorganisms: microbiology

Bacteria (singular form is bacterium) (see page 34 figure 2)

- Most primitive and most plentiful unicellular organisms on the planet
- Can be harmful: cause disease
- Can be helpful: make foods such as yogurt, cheese and make antibiotics
- Very successful at survival because they have changed little over billions of years
- Bacteria cells are prokaryotic: cells that lack intercellular organelles
- Some, like plants, can make their own food and some are parasites and can live by invading the body of an animal or a plant.
- Some bacteria can live without oxygen and are called **anaerobic** and some bacteria require oxygen and are called **aerobic** bacteria
- Bacteria cells have no nucleus, no mitochondria, and no ribosomes.
- All the activities performed in bacteria are not carried out by specially defined structures
- Bacteria can be killed by antibiotics. The problem is that overuse of antibiotics leads to resistance.

Protists

- Commonly found in pond water
- Have a nucleus, mitochondria and ribosomes

- Two types of protists: **plant-like** (are able to manufacture food) and **animal-like** (must ingest food). An exception is the Euglena

Plant-like Protists

Diatoms (See page 35 figure 3)

- Found in fresh and salt water
- Contain chlorophyll and can make their own food
- Encased in two thin shells joined together

Euglena (See page 35 figure 4)

- Like a plant and an animal cell.
- If there is lots of sunlight, euglena acts like a plant and makes its own food.
- If there is little sunlight, euglena acts like an animal and begins feeding upon smaller cells.
- Has a contractile vacuole that expels excess water.

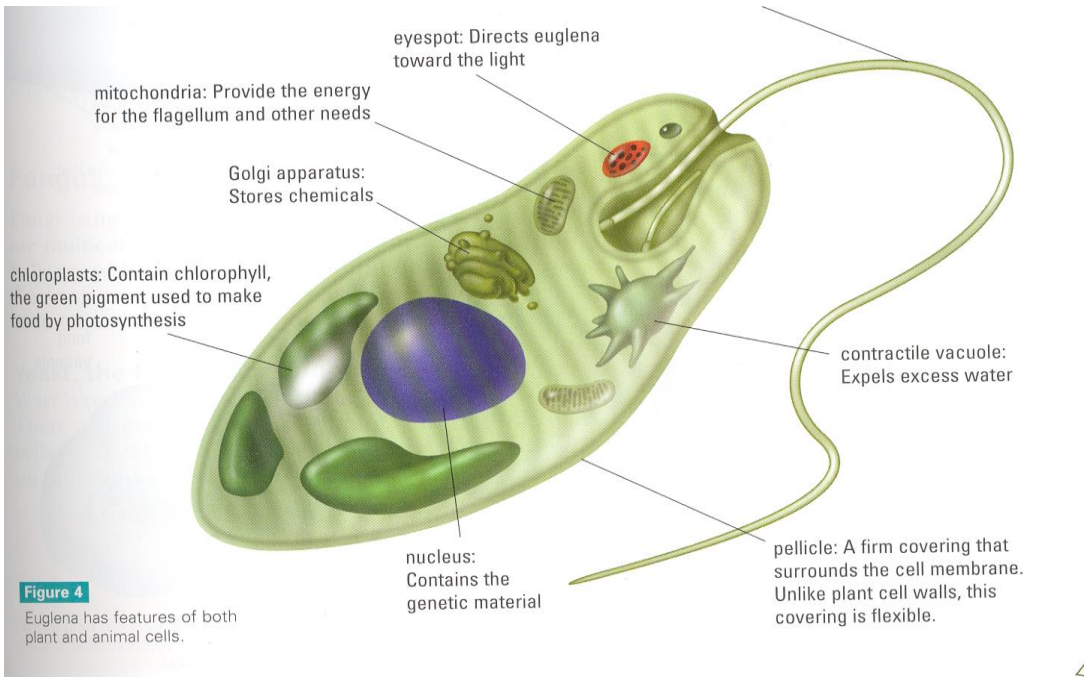


Figure 4
Euglena has features of both plant and animal cells.

Animal-like Protists

They cannot make their won food and must feed on things that are living or were once alive. They have all the organelles of an animal cell, and, like euglena, they have a contractile vacuole.

Amoeba (See page 36 figure 5)

- Blob-like organisms that move by stretching out a branch of cytoplasm called a "pseudopod" (false foot).
- The pseudopod anchors to an object and the rest of the cell is dragged toward it.
- The crawling motion is also used for feeding, as it warps itself around the food.

Paramecium (plural: paramecia) (See page 36 figure 6)

- Oval shaped organism that used hair-like structures called **cilia** to create water currents that move them around.
- Cilia around the paramecium's oral groove (primitive mouth) draw food into the groove.
- Bacteria and other smaller cells are their main food source.

Fungus (plural fungi)

- Mostly multicellular Ex. Mushrooms, bread mould and harmful fungi like ringworm, and athlete's foot.

1.16 Cell Wars

A **disease** is a condition that interferes with the well-being of an organism.

Many diseases are caused by agents that invade the body and interfere with the normal activities of the cell. The invasion is called **infection**.

Bacteria, fungi, parasitic worms rob cells of their nutrients or produce waste products that poison cells.

Viruses are not living things because they are not true cells. A virus contains no nucleus, cytoplasm, organelles, or cell membrane. The virus is a small strand of genetic information covered by a protein coat. They are only active when invading a living cell. They take over the cell and turn it into a factory for making more viruses. Viruses can cause cold sores, colds and the flu.

The defenders

Your immune system defends you by destroying invaders.

White blood cells engulf and digest invading bacteria. The white blood cell's lysosomes release special chemicals that destroy the invaders but also destroy the white blood cell.

Antibodies – made by a special type of white blood cell. They are large molecules that lock onto invading organisms.

See Stages of Infection on page 42 figure 1

1.18 From the Ground Up

- Water Absorption
- Water passes into the plant through root hairs.
- Root hairs are tiny extensions on the surface of the cells of a root. They increase the surface area of the cell membrane of the root cell.
- The cell membrane allows the water and dissolved nutrients, such as minerals to enter.

Tubes for Transport in Plants

Xylem vessels

Def: tubes used to transport water throughout the plant. They are formed from cell walls left behind as columns of cells die.

Phloem vessels

Def: Tubes used to transport sugars from the leaves to the stem and roots for food and storage. They also transport nutrients from the roots up to the leaves, as needed. They consist of living cells.